ECE 341 - Homework #12

t-Test with a Single Population. Summer 2023

6-Card Poker

The computed odds of being dealy 2-pair in 6-card poker are 12.44% (homework set #2).

1) The result of four Monte-Carlo simulations with 100,000 poker hands are:
   `12458, 12498, 12573, 12416`

From these results, determine the 90% confidence interval for the odds of getting 2-pair.

```
>> DATA = [12458, 12498, 12573, 12416];

>> x = mean(DATA)

x =  1.2486e+004

>> s = std(DATA)

s =   66.8250
```

From a t-table with 4 degrees of freedom, the t-score for 5% tails is 2.3534.

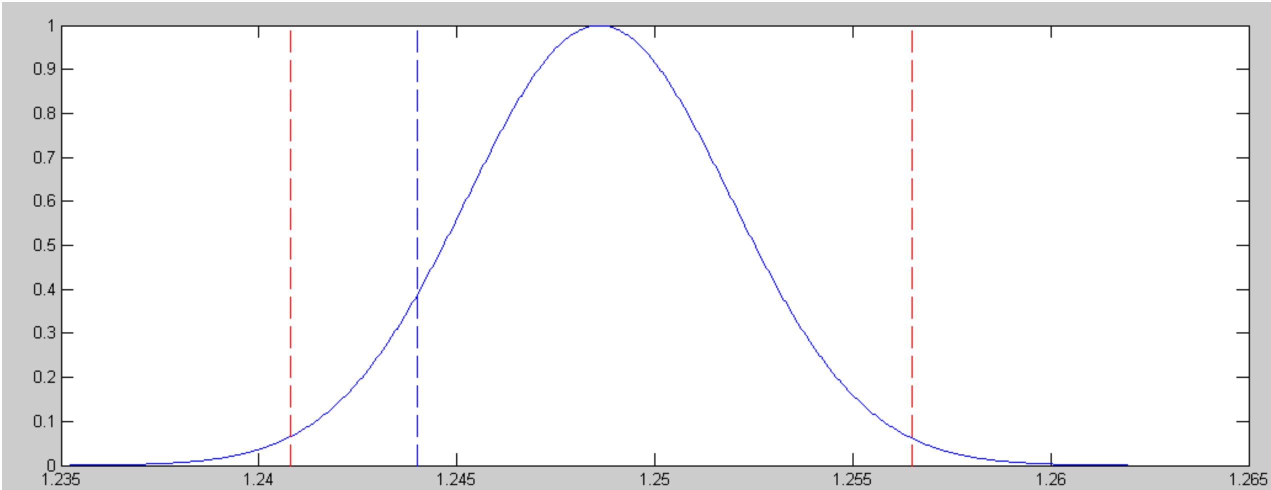
df \ p	0.001	0.0025	0.005	0.01	0.025	0.05	0.1	0.15	0.2
1	-636.619	-318.309	-63.6567	-31.8205	-12.7062	-6.3138	-3.0777	-1.9626	-1.3764
2	-31.5991	-22.3271	-9.9248	-6.9646	-4.3027	-2.92	-1.8856	-1.3862	-1.0607
3	-12.924	-10.2145	-5.8409	-4.5407	-3.1824	**-2.3534**	-1.6377	-1.2498	-0.9785
4	-8.6103	-7.1732	-4.6041	-3.7469	-2.7764	-2.1318	-1.5332	-1.1896	-0.941
5	-6.8688	-5.8934	-4.0321	-3.3649	-2.5706	-2.015	-1.4759	-1.1558	-0.9195
9	-4.7809	-4.2968	-3.2498	-2.8214	-2.2622	-1.8331	-1.383	-1.0997	-0.8834
19	-3.8834	-3.5794	-2.8609	-2.5395	-2.093	-1.7291	-1.3277	-1.0655	-0.861

Since we're trying to find the population's mean, divide the standard deviation by the square root of the sample size:

```
>> x + 2.35156*(s / sqrt(4))

ans =  1.2565e+004

>> x - 2.35156*(s / sqrt(4))

ans =  1.2408e+004
```

I'm 90% certain tha the odds of being dealt 2-pair are in the range of (12,408 to 12,565)

12,440 is in this range



pdf for the odds of 2-pair in 100,000 hands.
90% confidence interval (red dash lines)
Actual probability (blue dash line)

2) The result of twenty Monte-Carlo simulations with 100,000 poker hands are:

```
12591, 12323, 12404, 12622, 12309, 12317, 12544, 12503, 12410, 12483
12385, 12303, 12458, 12418, 12415, 12417, 12309, 12378, 12444, 12463
```

From these results, determine the 90% confidence interval for the odds of getting 2-pair.

Get the data into Matlab

```
>> a = [ 12591, 12323, 12404, 12622, 12309, 12317, 12544, 12503, 12410, 12483];
>> b = [ 12385, 12303, 12458, 12418, 12415, 12417, 12309, 12378, 12444, 12463];
>> DATA = [a,b];
```

Find the mean and standard deviation:

```
>> x = mean(DATA)

x =  1.2425e+004

>> s = std(DATA)

s =   92.1724
```

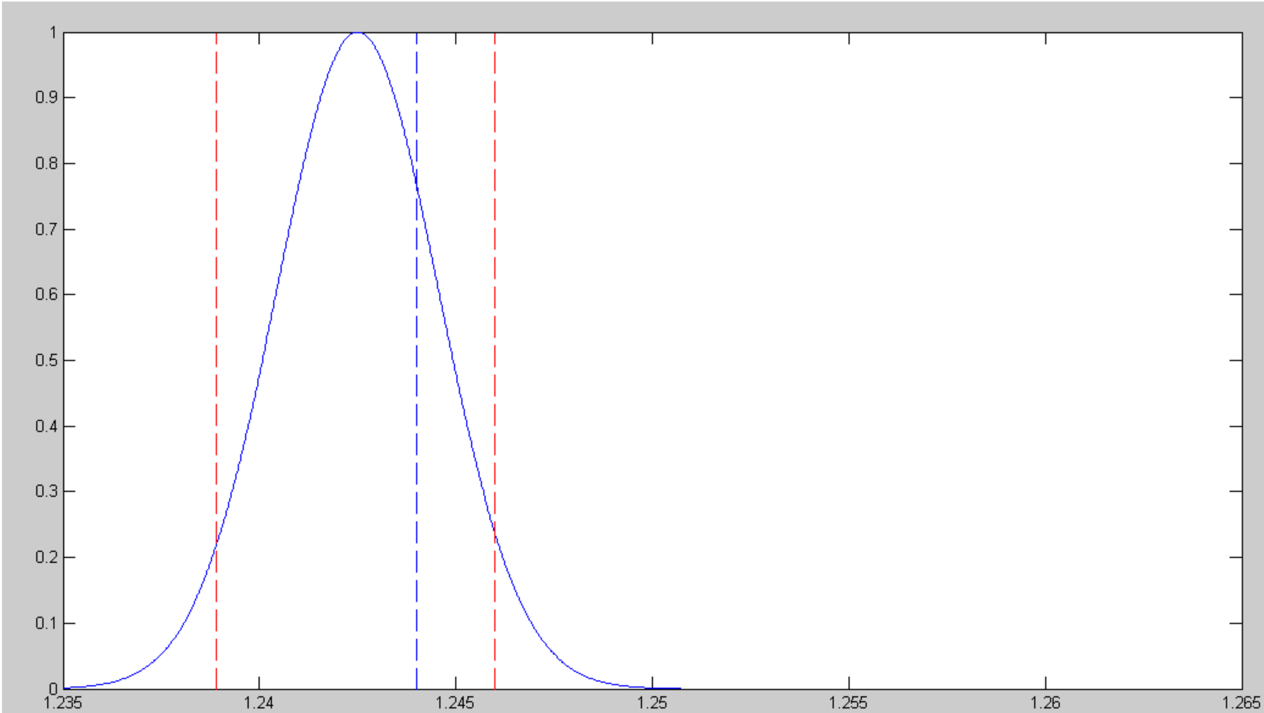
From a t-table with 19 degrees of freedom, the t-score for 5% tails is 1.7291

df \ p	0.001	0.0025	0.005	0.01	0.025	0.05	0.1	0.15	0.2
1	-636.619	-318.309	-63.6567	-31.8205	-12.7062	-6.3138	-3.0777	-1.9626	-1.3764
2	-31.5991	-22.3271	-9.9248	-6.9646	-4.3027	-2.92	-1.8856	-1.3862	-1.0607
3	-12.924	-10.2145	-5.8409	-4.5407	-3.1824	-2.3534	-1.6377	-1.2498	-0.9785
4	-8.6103	-7.1732	-4.6041	-3.7469	-2.7764	-2.1318	-1.5332	-1.1896	-0.941
5	-6.8688	-5.8934	-4.0321	-3.3649	-2.5706	-2.015	-1.4759	-1.1558	-0.9195
9	-4.7809	-4.2968	-3.2498	-2.8214	-2.2622	-1.8331	-1.383	-1.0997	-0.8834
19	-3.8834	-3.5794	-2.8609	-2.5395	-2.093	**-1.7291**	-1.3277	-1.0655	-0.861

```
>> low = x - 1.72852*(s/sqrt(20))

low =  1.2389e+004

>> high = x + 1.72852*(s/sqrt(20))

high =  1.2460e+004
```

I'm 90% certain the odds of being dealt t-pair are in the range of (12,389 to 12.460)

12,440 is in this range



pdf for the odds of 2-pair in 100,000 hands.
90% confidence interval (red dash lines)
Actual probability (blue dash line)

Note: With a larger sample size, you have a tighter band on where the actual odds are

6-Card Draw

The computed odds of getting four-of-a-kind in 6-card poker with a draw step are 0.0068287 (homework set #2)

3) The result of four Monte-Carlo simulations with 100,000 poker hands are:

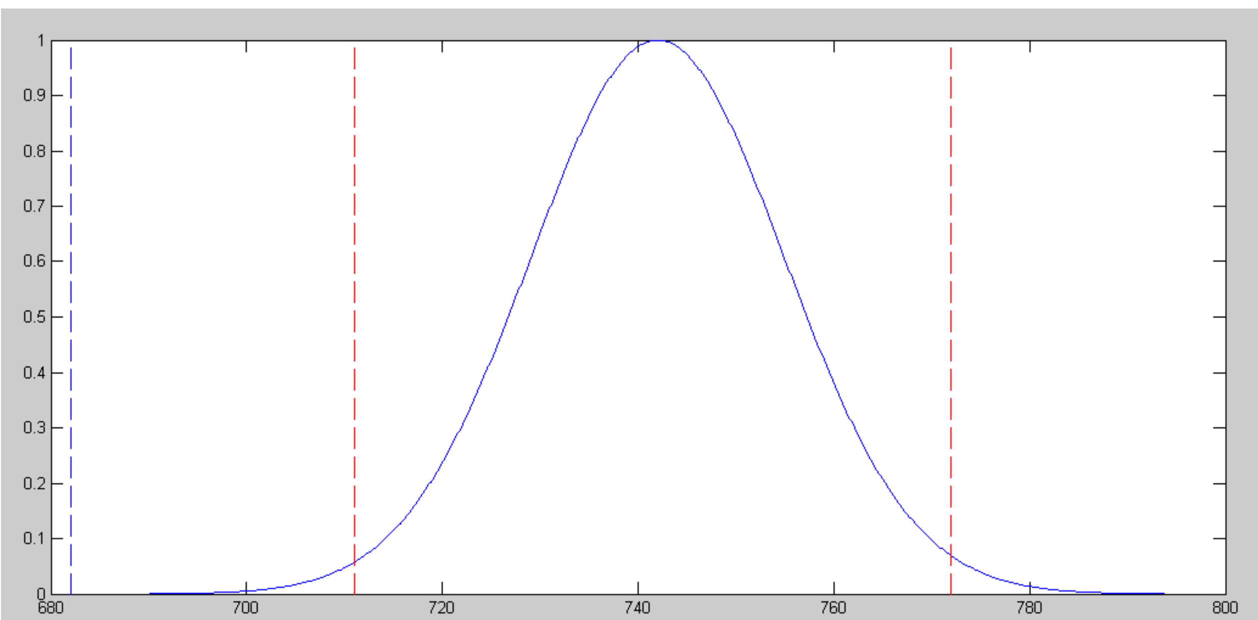
```
718, 742, 778, 730
```

From these results, determine the 90% confidence interval for the odds of getting four of a kind.

```
>> DATA = [718, 742, 778, 730];
>> x = mean(DATA)

x =   742

s =   25.9230

>> low = x - 2.35156*(s/sqrt(4))

low =  711.5203

>> high = x + 2.35156*(s/sqrt(4))

high =  772.4797
```

I'm 90% certain the odds are in the range of (711.49 , 771.49)

actual = 682.87



pdf for the odds of 4 of a kind in 100,000 hands.
90% confidence interval (red dash lines)
Actual probability (blue dash line)

4) The result of twenty Monte-Carlo simulations with 100,000 poker hands are:

```
791, 763, 789, 741, 734, 748, 761, 765, 714, 754
770, 768, 770, 761, 751, 790, 754, 772, 719, 736
```

From these results, determine the 90% confidence interval for the odds of getting four of a kind.

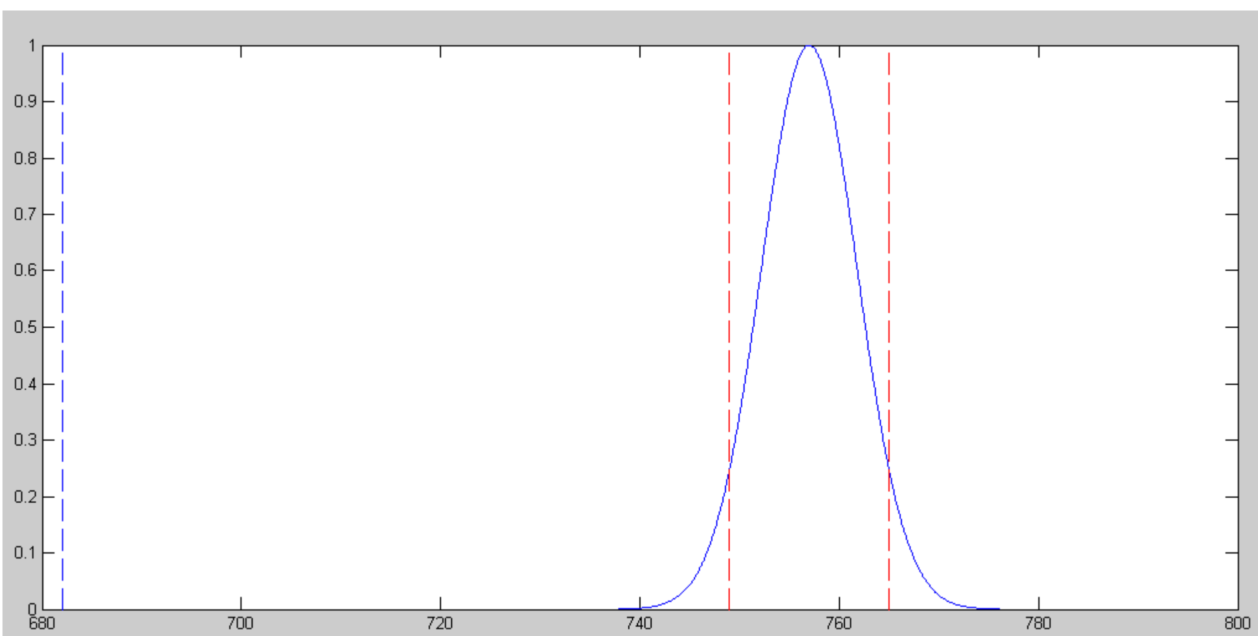
```
>> a = [791, 763, 789, 741, 734, 748, 761, 765, 714, 754];
>> b = [770, 768, 770, 761, 751, 790, 754, 772, 719, 736];
>> DATA = [a,b];
>> x = mean(DATA)

x =  757.5500

>> s = std(DATA)

s =   21.4390

>> high = x + 1.72852*(s/sqrt(20))

high =  765.8391

>> low = x - 1.72852*(s/sqrt(20))

low =  749.2609
```

I'm 90% certain the odds of being dealt 4-of-a-kind are in the range of (749.26, 765.84)

computed odds are 682.87

Either my Monte-Carlo simulation has an error or my computations have an error

or both...



pdf for the odds of 4 of a kind in 100,000 hands.
90% confidence interval (red dash lines)
Actual probability (blue dash line)

Reaction Time

5) Go to the Human Benchmark Dashboard and record your reaction time

`https://humanbenchmark.com/tests/reactiontime`

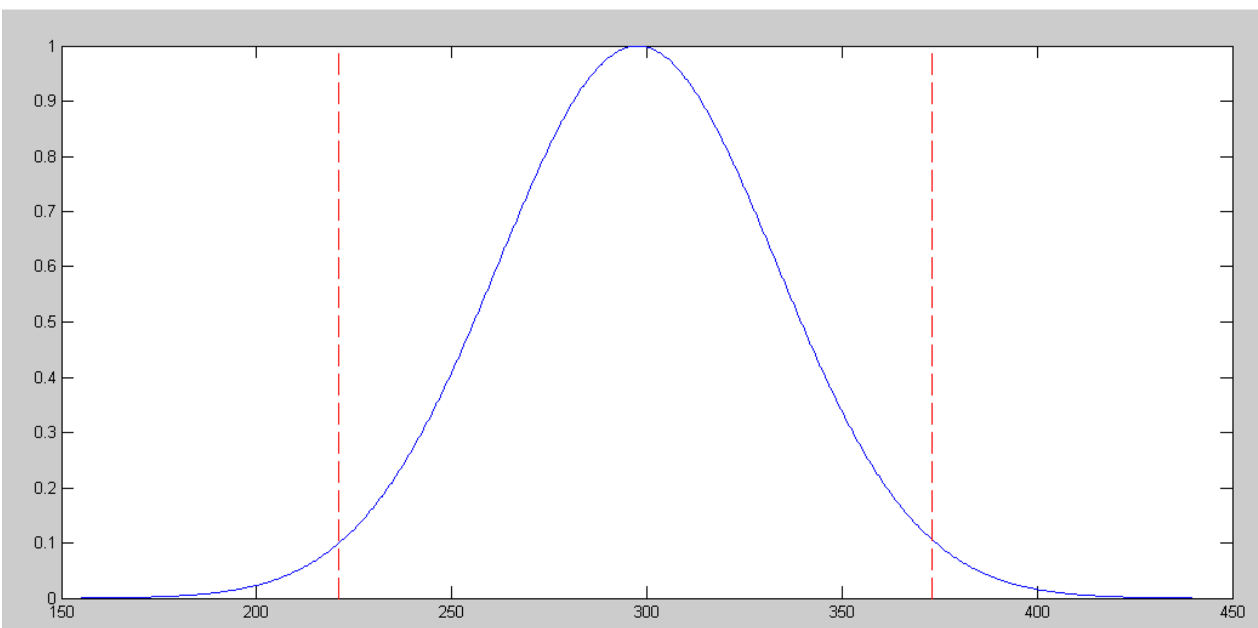
Time (ms) = {310, 257, 278, 351, 292}

----

6) From your results, determine the 90% confidence interval for your reaction time.

```
>> ms = [310, 257, 278, 351, 292];
>> X = mean(ms)

X =  297.6000

>> s = std(ms)

s =   35.5992

>> high = X + 2.1318*s

high =  373.4903

>> low = X - 2.1318*s

low =  221.7097
```

My reaction time should be in the range of (221.71ms, 373.49ms) 90% of the time



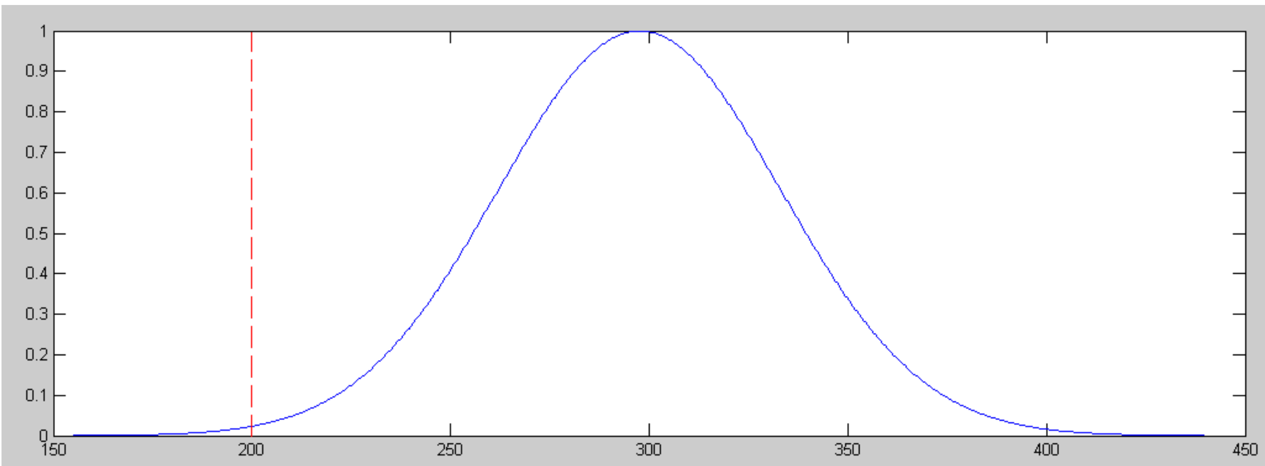
7) From your results, determine the probability that

- Your next trial will be less than 200ms
- Your average reaction time is less than 200ms

```
>> t = (X - 200) / s

t =    2.7416
```

This corresponds to a probability of 2.5%

I have a 2.5% chance of scoring less than 200ms in my next trial

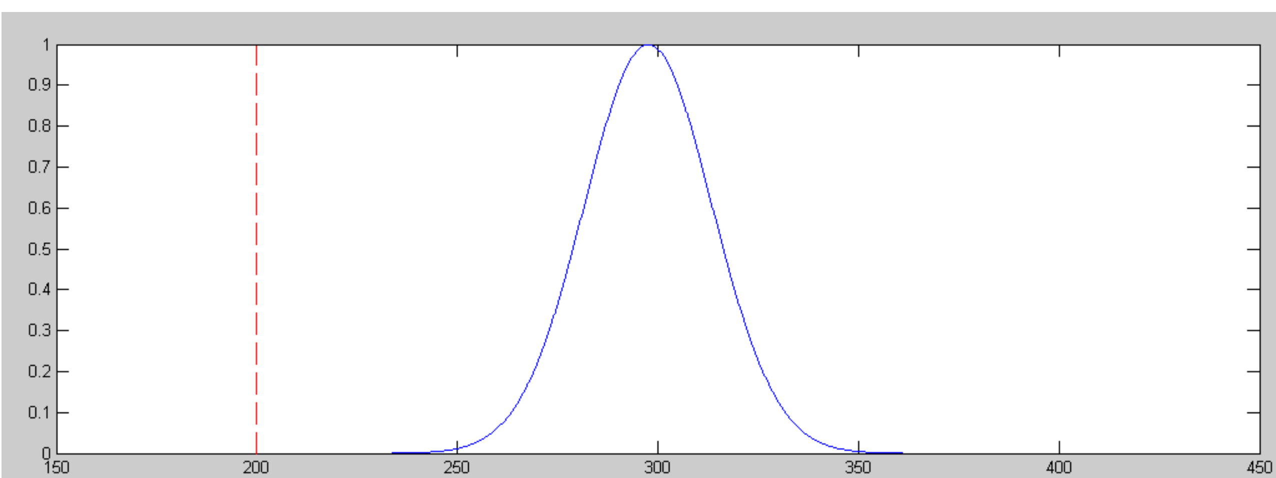


pdf for my next trial (individual). 2.5% chance it will be less than 200ms

```
>> t = (X - 200) / (s / sqrt(5))

t =    6.1305
```

This corresponds to a probability of 0.003 (about)

There is a 0.3% chance my overall reaction time is less than 200ms



pdf for my overall average reaction time (population). 0.3% chance it's less than 200ms